Sept. 22, 1959 W. G. MONTGOMERY ET AL 2,905,084

TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 1

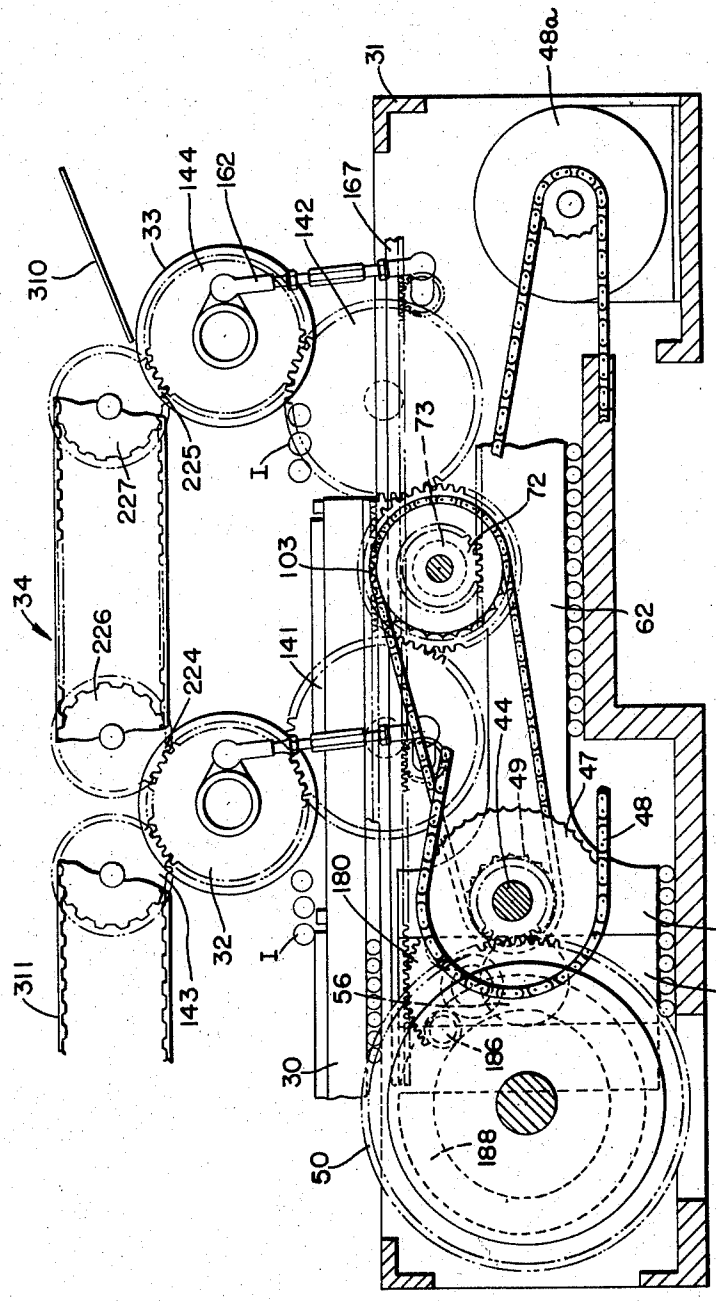


FIG. 1

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TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 2

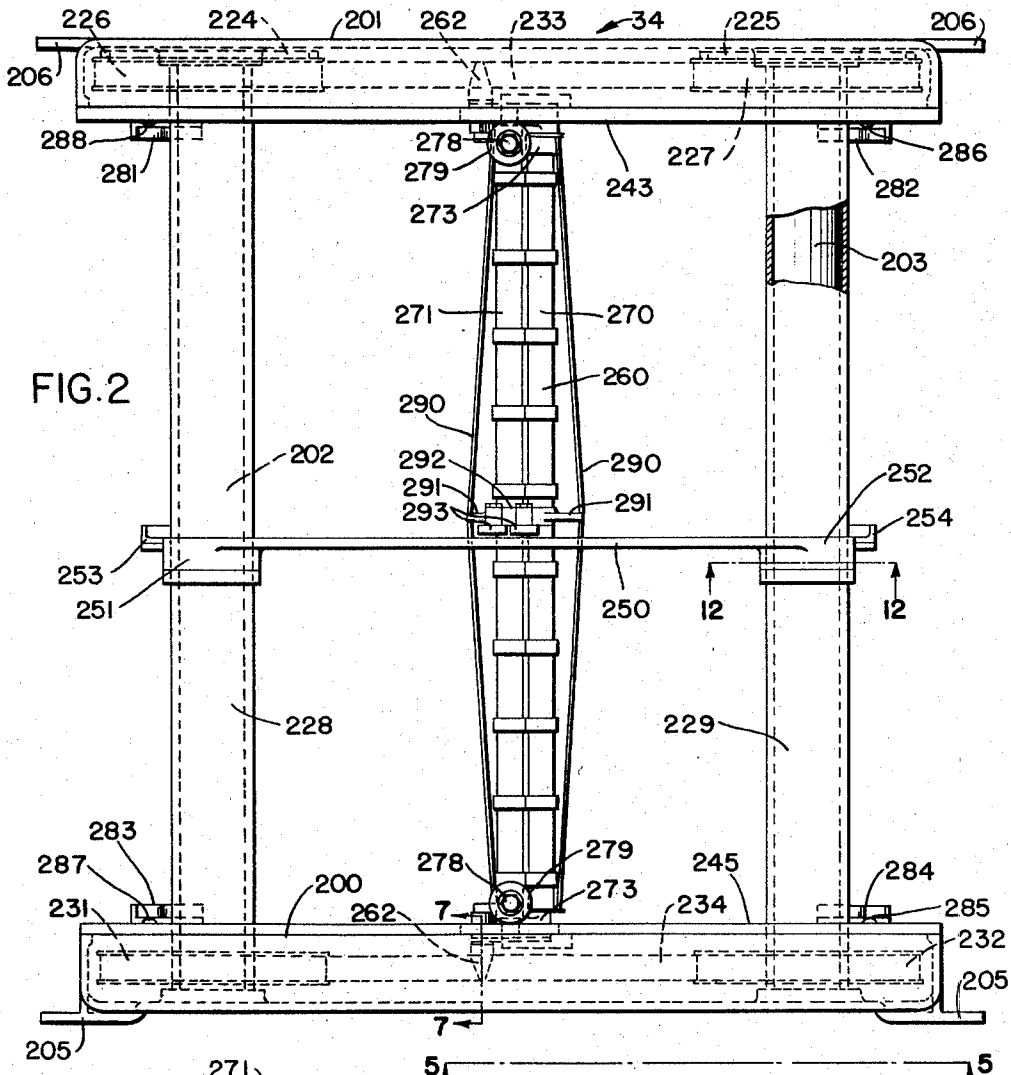


FIG. 2

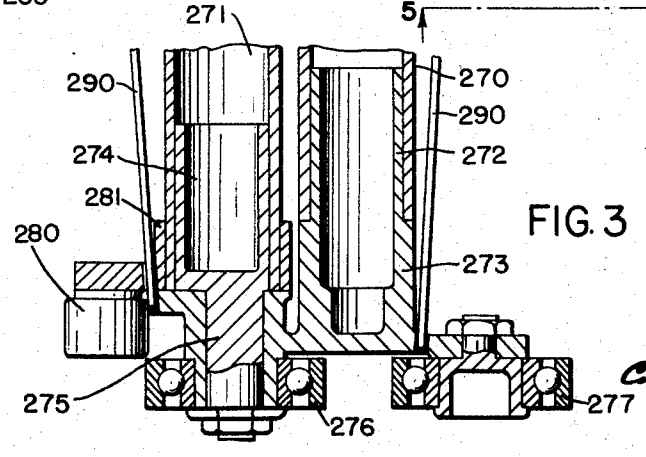


FIG. 3

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Sept. 22, 1959 W. G. MONTGOMERY ET AL 2,905,084

TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 3

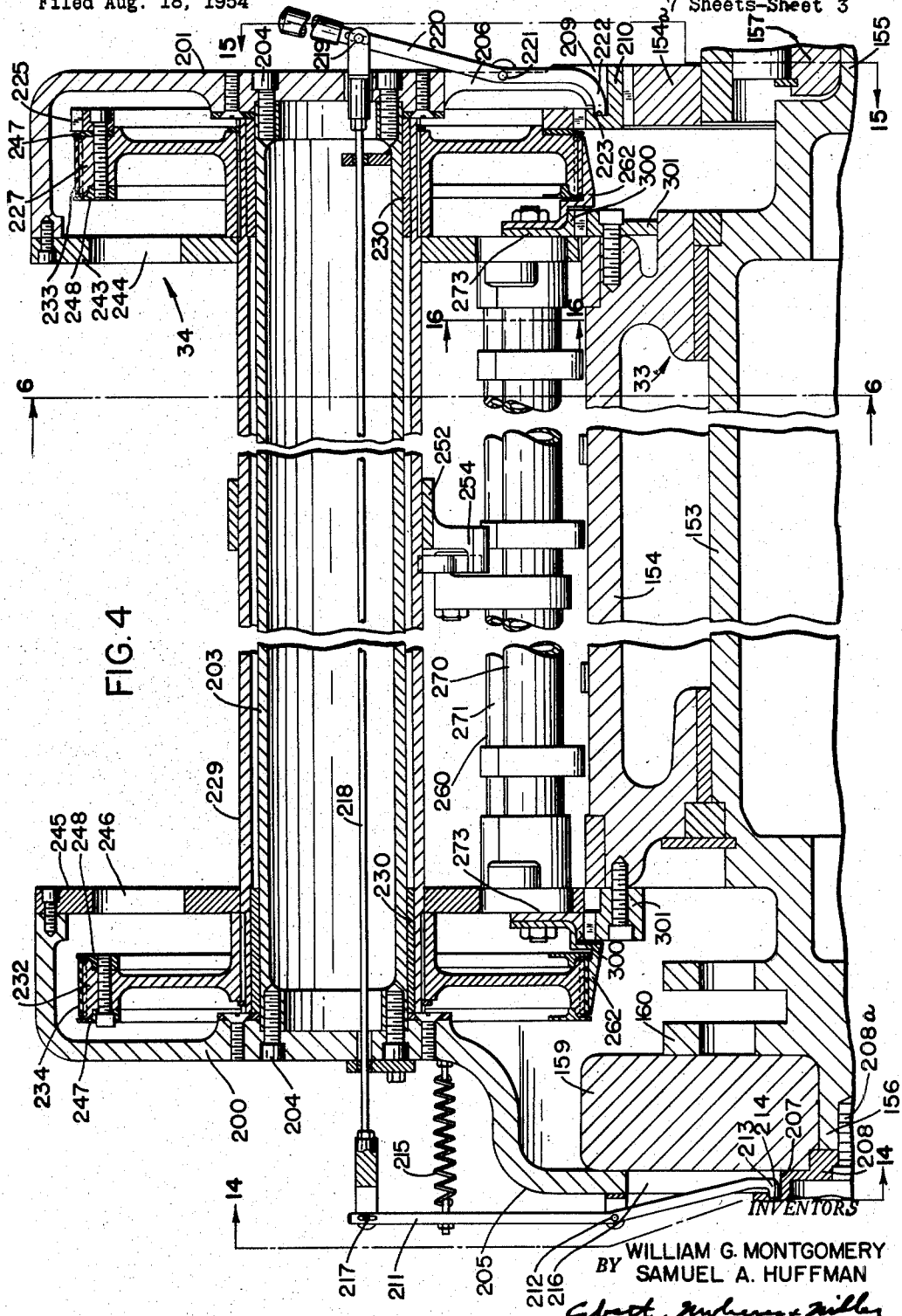


FIG. 4

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TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 4

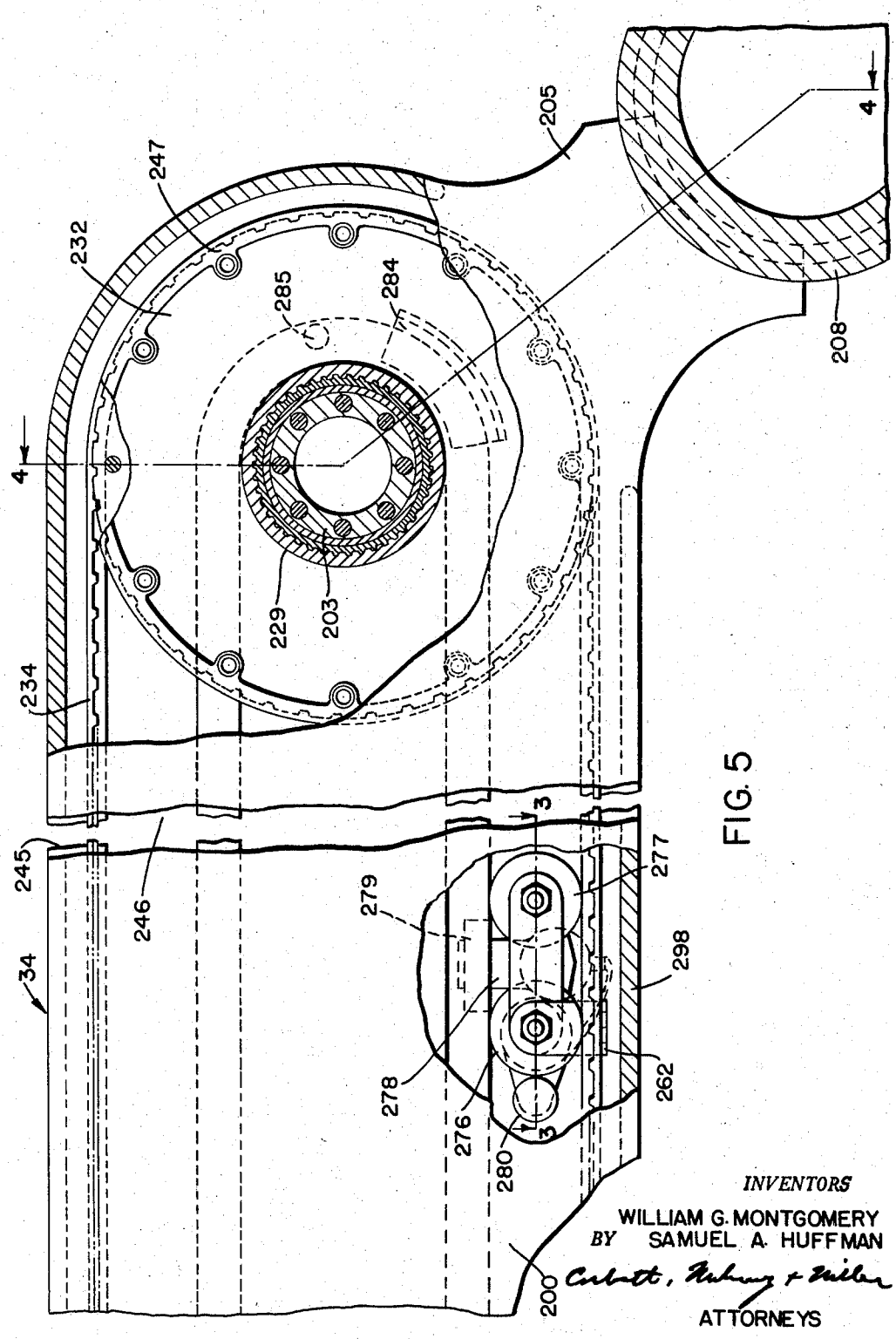


FIG. 5

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TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 5

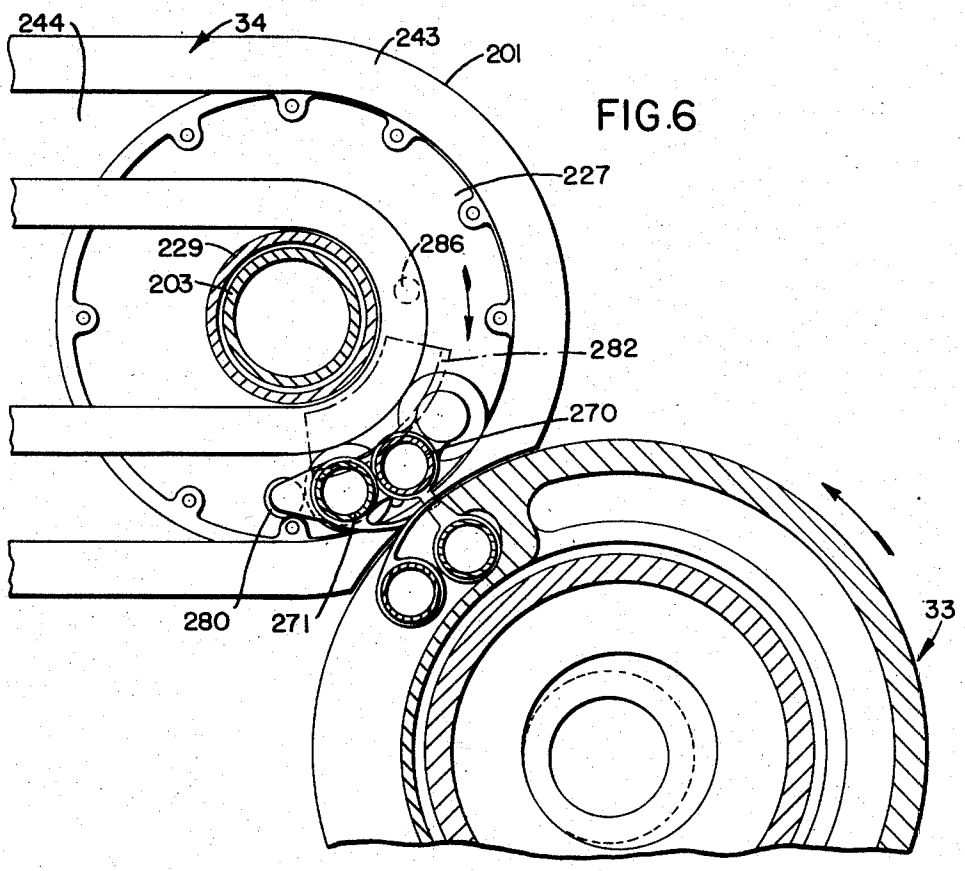


FIG.6

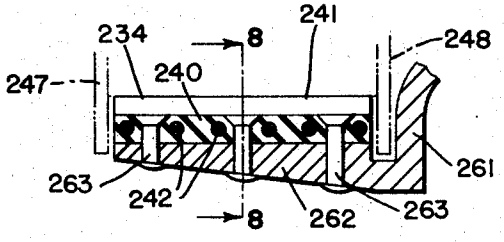


FIG.7

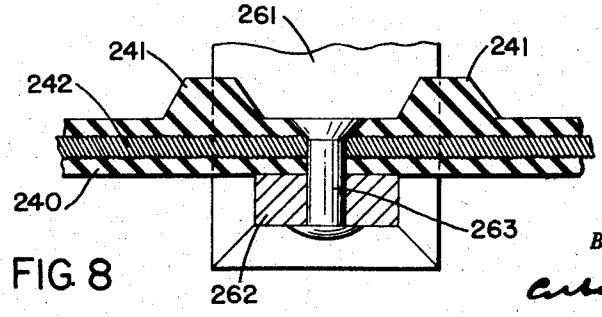


FIG. 8

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Sept. 22, 1959 W. G. MONTGOMERY ET AL 2,905,084

TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 6

FIG. 11

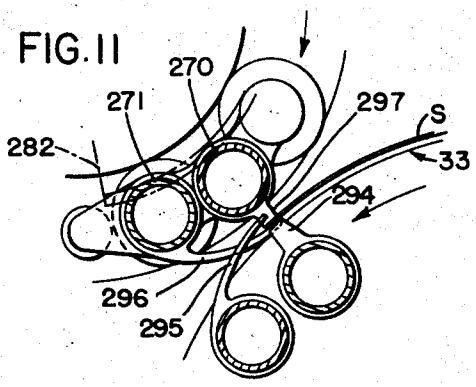


FIG. 10

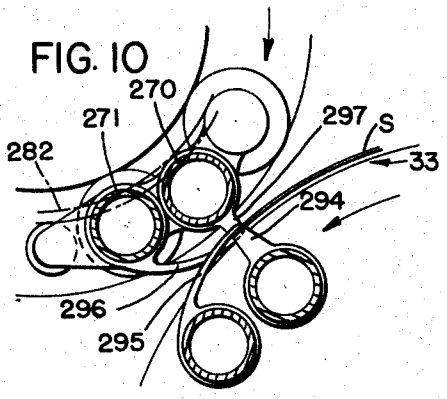
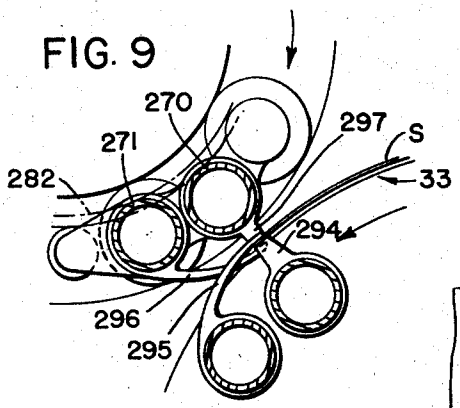


FIG. 9



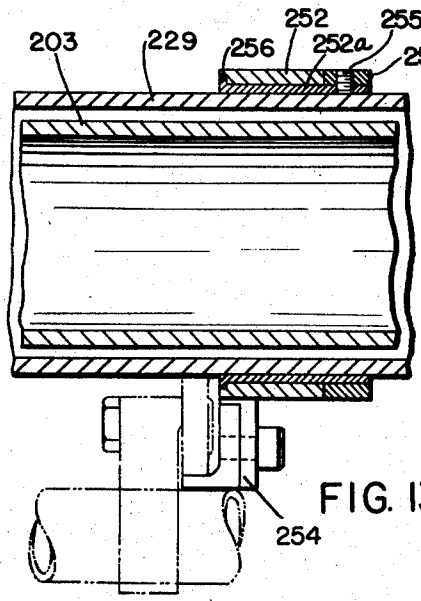
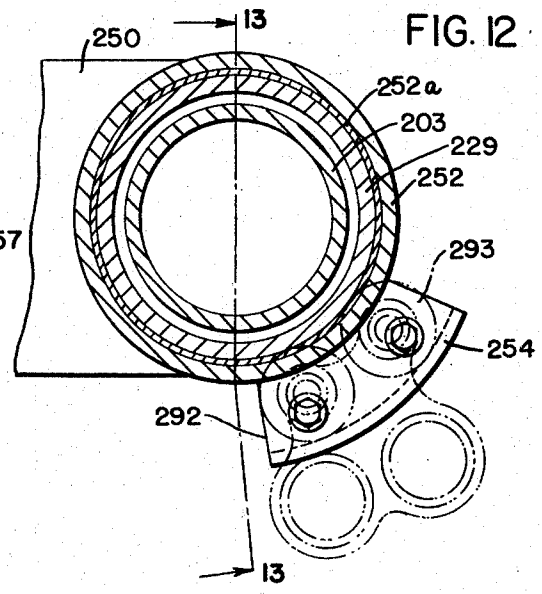


FIG. 13

FIG. 12



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TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

Filed Aug. 18, 1954 7 Sheets-Sheet 7

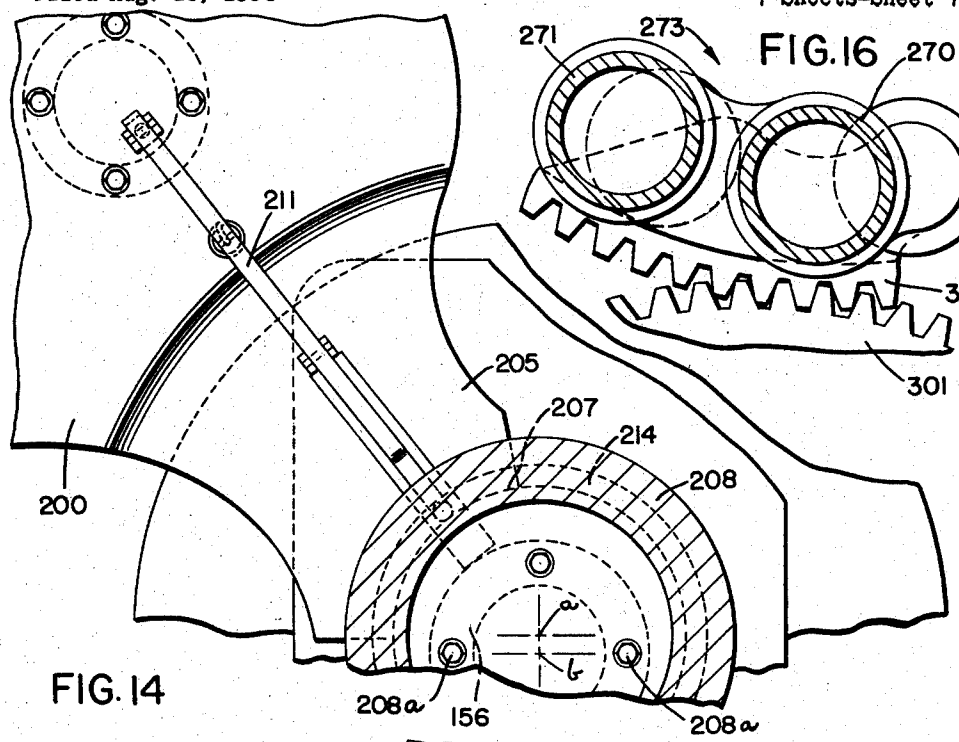


FIG. 14

FIG. 16

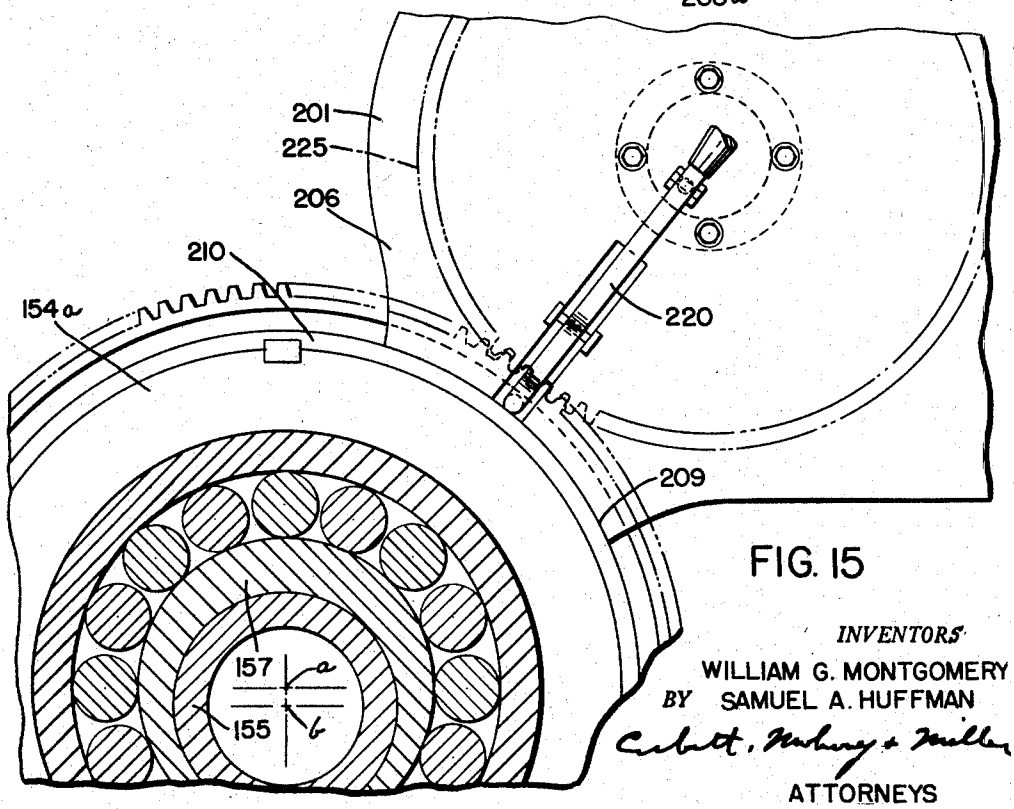


FIG. 15

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United States Patent Office 2,905,084
Patented Sept. 22, 1959

2,905,084

TRANSFER UNIT FOR A MULTI-CYLINDER PRINTING PRESS

William G. Montgomery, Marietta, and Samuel A. Huffman, Cincinnati, Ohio; said Huffman assignor to said Montgomery

Application August 18, 1954, Serial No. 450,585

12 Claims. (Cl. 101—191)

Our invention relates to transfer unit for a multi-cylinder printing press. It relates, more specifically, to a transfer unit for use in a multi-color press of the reciprocable bed and two-revolution cylinder type, but features thereof are not necessarily limited to that type of press.

This application is a continuation-in-part of our copending application Serial No. 197,218, filed November 24, 1950 and now Patent No. 2,737,110.

The transfer unit of the present invention has all of the basic features and advantages of the unit described in our copending application. In addition, it is provided with improvements which give it additional advantages.

As explained in said copending application, existing two-color flat-bed and cylinder printing presses have a transfer cylinder which has a diameter equal to one-half the diameter of the printing cylinders and which is located between the two printing cylinders for the purpose of carrying a sheet from one cylinder to the other. This arrangement has a number of disadvantages. In the first place, during the transfer of the sheet from one cylinder to the other, the wet ink of the printed surface is towards or next to the transfer cylinder surface. Consequently, great care and precaution must be taken and means provided to prevent the printed sheet from being smeared or smudged. Also, thick sheets, such as cardboard, are difficult or even impossible to bend around the transfer cylinder without cracking or other such damage to the sheets. Furthermore, the transfer cylinder is in a fixed position between the printing cylinders and cannot be moved away from either of the cylinders at any time and, therefore, it is very difficult to make ready each of the printing cylinders because of interference by the transfer cylinder. In addition, the inkers are necessarily located on opposite sides of each of the printing cylinders and are, therefore, not identical, being right and left hand. Many of the parts of the two inkers are different because they are right and left hand. Adjustments and settings, therefore, are different and contrary to standard single-color practice requiring the most experienced pressmen to make these adjustments and settings and it is also more difficult to adjust the two type forms which must necessarily be located differently than in single-color presses. The arrangement of the transfer cylinder relative to the printing cylinders makes it impossible to design a press with such a transfer arrangement to print more than two colors. Furthermore, with this transfer arrangement, cylinders of larger diameter are required and, consequently, a longer stroke of the bed is required than for single-color presses for printing the same size sheet. All of these disadvantages of prior art two-color presses are true whether the press is of the two-revolution cylinder type or the stop-cylinder type.

One of the objects of our invention is to provide a multi-color printing press of the type indicated above which is provided with transfer means including registering devices which will carry sheets from one cylinder to the next in absolute register.

A further object is to provide a multi-color press of the type indicated wherein the transfer means is such that the sheets are carried from cylinder to cylinder with nothing touching the printed side thereof so as to eliminate any danger of smearing.

Another object of our invention is to provide a multi-color press of the type indicated wherein the printed sheets will be transferred from one cylinder to the next in flat condition which makes it possible to handle heavy cardboard or the like without cracking or other damage thereto.

Another object of our invention is to provide a transfer unit which can be moved readily to a position to permit the make-ready operation without interference and in substantially the same manner as with a single-color press.

Another object of our invention is to provide a transfer unit for a multi-cylinder press which is so designed that it will move properly with the cylinders when they are both moved towards or from the bed or will move without binding when one cylinder only is moved relative to the bed, these movements being accomplished without interference with the driving means for the transfer unit.

Still another object of our invention is to provide a transfer unit which consists of an endless conveyer extending between adjacent cylinders which carries a single gripper bar so that successive sheets are engaged and removed from the impression cylinder by the same gripper bar thereby ensuring registery with the next cylinder to which each sheet is transferred.

A further object of our invention is to provide a transfer unit of the type indicated in which the endless conveyer is of such design and construction that it will be of accurate predetermined dimensions and will maintain such dimensions during extended use so that accurate registry can be obtained and maintained.

Various other objects will be apparent from the drawings and the following description and claims.

The preferred embodiment of our invention is illustrated in the accompanying drawings wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a side elevational view of our transfer unit showing it applied to a multi-cylinder press.

Figure 2 is a plan view of the transfer unit.

Figure 3 is a transverse horizontal sectional view taken on line 3—3 of Figure 5 showing one end of the gripper bar of the transfer unit.

Figure 4 is a vertical transverse sectional view taken through the transfer unit along line 4—4 of Figure 5 and showing how it is associated with one of the cylinders of the press.

Figure 5 is a side elevational view, partly broken away, of one end of the transfer unit taken substantially along line 5—5 of Figure 2.

Figure 6 is a longitudinal vertical sectional view taken along line 6—6 of Figure 4 showing the gripper bar in association with one of the cylinders.

Figure 7 is a transverse sectional view through the conveyer belt taken along line 7—7 of Figure 2.

Figure 8 is a longitudinal sectional view taken through a portion of the conveyer belt along line 8—8 of Figure 7.

Figure 9 is a vertical longitudinal sectional diagrammatic view illustrating the gripper bar and an associated cylinder from which the printed sheet is being transferred, the grippers on the cylinder being in engagement with the sheet and the grippers on the gripper bar being in position to engage the sheet.

Figure 10 is a similar view but showing both sets of grippers in engagement with the sheet.

Figure 11 is a similar view but showing the cylinder grippers released from the sheet and the bar grippers engaging the sheet.

Figure 12 is a longitudinal vertical sectional view taken along line **12—12** of Figure 2 through one of the transverse tube units at the end of the transfer unit and showing the cam associated therewith for preventing outward deflection of the gripper bar as it passes therearound.

Figure 13 is a vertical transverse sectional view taken substantially along line **13—13** of Figure 12.

Figure 14 is a side elevational view taken along line **14—14** of Figure 4 showing how the transfer frame is supported at one side on the impression cylinder for vertical movement therewith.

Figure 15 is a similar view but taken on line **15—15** of Figure 4 to show the supporting means at the other side of the transfer unit.

Figure 16 is a vertical sectional view taken substantially along line **16—16** of Figure 4 showing the registering racks on the end of the gripper bar and the cylinder shell.

We have illustrated and will describe our transfer unit applied to a multi-cylinder flat bed and cylinder printing press of the type shown and described in our copending applications Serial No. 197,218, filed November 24, 1950, and now Patent No. 2,737,110 and Serial No. 444,968, filed July 22, 1954, and now Patent No. 2,790,383 which we will designate respectively as our first and second copending applications. However, it is to be understood that it may be applied to other types of presses. The press shown in the drawings is of the type in which the bed is reciprocated with a full harmonic motion, each impression cylinder is rotated in the same direction at all times regardless of the direction of movement of the bed, the rotation of each cylinder is timed with the movement of the bed so that cylinder rotation and bed motion are in exact synchronism at all times, and each cylinder is in contact with a form carried by the bed during movement of the bed in one direction, that is, during the printing stroke, but is lifted therefrom during movement of the bed in the opposite direction, that is, during the return stroke. The transfer unit of this invention is adapted to transfer the printed sheet from one impression cylinder to another in exact registry so that one cylinder can print one color and the other cylinder another color. Although, we have shown only a single transfer unit applied to the press, it is to be understood that it may be used in any suitable numbers depending upon the number of cylinders on the press.

In Figure 1, we have illustrated our transfer unit **34** disposed between the impression cylinder **32** and the impression cylinder **33** for transferring the sheets, after being printed on cylinder **33**, to the cylinder **32** in exact registry.

The general structure of this press is the same as that shown in our second copending application. It includes the single bed **30** which is mounted on the main frame **31** for reciprocation longitudinally thereof in a horizontal plane and two transversely disposed impression cylinders **32** and **33** which are carried by the frame and are located above the path of movement of the bed, the cylinders having their transverse axes spaced longitudinally of the press. These two cylinders **32** and **33** are adapted to cooperate with two printing forms F which will be suitably removably attached to the bed **30** at proper locations spaced longitudinally of the bed.

In the press illustrated, we have shown the bed horizontally disposed. However, our invention is not necessarily limited to a horizontal press but the features thereof can apply to a vertical press. The press illustrated in Figure 1 is for printing two colors, since it is shown with two impression cylinders, but it is to be understood that the press may have any number of cylinders which will be used with the same number of forms supported on the bed in properly spaced relationship, the number of cylinders depending upon the number of colors desired, and

the number of our transfer units depending upon the number of cylinders.

The frame **31** is described in detail in our first copending application and supports the bed **30** for longitudinal reciprocation. The driving mechanism for the bed **30** reciprocates with a full harmonic motion and includes a rack **62** which is carried by a Scotch yoke **60**, and which is reciprocated by means of a crank roller **56** which operates in a vertical slot or groove **58** formed in the Scotch yoke, the roller **56** being carried by a driven crank gear **50**.

The crank gear **50** is driven by means of a pinion **49** which meshes therewith and which is keyed on the transverse shaft **44** that is driven continuously, when the press is operating, by means of a sprocket **47** keyed thereon. This sprocket **47** is driven by a chain **48** from an electric motor **48***a* supported at one end of the press within the frame **31**.

The rack bar **62** of the yoke **60** engages a pinion **72**, as shown in Figure 1, and this pinion is keyed on a hollow transverse shaft **73**. Thus, reciprocation of the yoke **60** will oscillate the pinion **72** and thereby oscillate the shaft **73**, and this shaft reciprocates the bed **30** as described in our second copending application. As previously indicated, the impression cylinders **32** and **33**, which are carried on the frame **31** above the bed **30**, are rotated in one direction at all times and in exact synchronism with the bed **30** at all times. These cylinders are driven from the bed driving means by a variable speed drive which drives the cylinders in the same direction during the movement of the bed in both directions. Driving of the impression shells of the cylinders **32** and **33**, as explained in our second copending application, is accomplished with a single clutch unit **103** which is associated with the shaft **73**. The clutch **103** simultaneously drives the gears **141** and **142** in the same direction and these gears mesh, respectively, with the cylinder gears **143** and **144** associated with the cylinders **32** and **33**.

As further explained in our second copending application, the impression shells of the cylinders **32** and **33** are raised and lowered relative to the bed **30** during the return and printing stroke, respectively, of the bed by means of an eccentric arrangement associated with each cylinder and actuated by a rack member **167**, which is reciprocably mounted on the frame **31**, through a crank and connecting rod arrangement **162**. The rack member **167** is reciprocated by means of a gear segment **180** which is oscillated by means of a roller **186** that operates in a cam track **188** in the driven crank gear **50**.

Thus, the cylinders **32** and **33** are driven in the same direction and are raised and lowered in timed relationship to the movement of the bed **30**.

The transfer unit **34**, as previously indicated, is disposed between the cylinders **32** and **33** and will move vertically with either one or both of the cylinders.

The unit **34** includes the side frame members **200** and **201** as shown best in Figures 2 and 4 which extend longitudinally at each side of the press between and above the level of the cylinders **32** and **33**. These frame members are joined together by transverse hollow tie rods **202** and **203**, disposed adjacent the ends of the frame members, which also serve as supports for the endless conveyor as will be apparent later. Both rods **202** and **203** are connected to the frame members **200** and **201** in the same manner and in Figure 4 we have illustrated the connecting arrangement for the rod **203**. It will be noted from this figure that each frame member has the lag bolts **204** extending therethrough and into the adjacent end of the rod **203**. Thus, the frame members **200** and **201** are rigidly tied together by the tie rods **202** and **203**.

The transfer unit **34** is supported by the eccentrics which produce the raising and lowering of the impression shells of the cylinders **32** and **33**, in the manner described in our second copending application, so that the

transfer unit will be raised and lowered with the cylinders. Each cylinder has an eccentric shaft associated with it and in Figure 4 we have shown the eccentric shaft **153** which is oscillated by the connecting rod **162** that is connected to the lugs **160** extending radially therefrom, the rod **162** being shown in Figure 1 but not in Figure 4. The frame members **200** and **201** are supported at their ends by the eccentric shafts **153** of the respective cylinders **32** and **33**. For this purpose, the frame member **200** is provided at each end with a downwardly and outwardly extending supporting arm **205** (Figures 5 and 14) and the frame member **201** is provided with a similar arm **206** at each end, one being shown in Figures 4 and 15. Each of the supporting arms **205** is provided with a supporting yoke **207** formed on its lower end (Figures 4, 5 and 14) which will rest on a bearing disc **208** (Figure 4) which is bolted by the lag bolts **208***a* to the adjacent eccentric trunnion end **156** of the associated cylinder shaft **153**. Disc **208** is concentric with the main part of the shaft **153** as indicated by the dotted lines in Figure 14, where "*a*" is the center of the cylinder shell **154** and disc **208** and "*b*" is the center of the trunnion end **156**. Each of the supporting arms **206** has a supporting yoke **209** (Figures 4 and 15) which engages the hub of a ring gear **210** that is keyed to the ring **154***a* which is a part of and moves vertically with the cylinder shell **154**. The axis of the hub of the gear **210** is concentric with the cylinder shell and eccentric to the axis of the trunnion end **155** of the cylinder shaft **153**, and its bearing **157**, as shown by the center lines in Figure 15 where "*a*" is the center of gear **210** and "*b*" is the center of the trunnion end **155**. The gear **210** is concentric with the ring **154***a* which is eccentric with the trunnion **155**. The gear **210** will serve as a transfer registering and driving gear and since it will rotate with the shell **154** and will move vertically therewith, the frame member **201** will move vertically to the same extent and at the same time as the frame member **200** which is moved by disc **208**.

With this arrangement, the entire transfer unit can be swung upwardly out of the way, either about the common axis adjacent the cylinder **33** which runs through the gear **210** and the disc **208** or the common axis adjacent the other cylinder **32** which runs through corresponding members. This will permit make-ready in a manner like that followed previously in a single color press since it will permit ready access to the inker rollers I (Figure 1) which are located adjacent the cylinder **33** in the usual location for a single cylinder press. The inkers I for the cylinder **32** are similarly located relative to that cylinder.

At each end of the transfer unit **34** locking means is provided for locking the corresponding end of the transfer unit in association with the adjacent cylinder. The locking means at the end adjacent the cylinder **33** is shown in Figures 4, 14 and 15. This means comprises a locking lever **211** which is shown at the left hand side in Figure 4 and in Figure 14. This lever is pivoted at **212** to the arm **205** of the transfer frame. The lower outwardly turned hooked end **213** of the lever normally extends into an annular groove **214** formed concentrically in the bearing member **208**. The hooked end is normally held in the groove by means of a tension spring **215** provided between the upper end of the lever **211** and the arm **205**. A slot **216** in the arm **205** permits the necessary swinging movement of the lower end of the lever. The upper end of the lever **211** is connected by a pin and slot connection **217** to one end of a connecting rod **218** which passes through the hollow tie rod **203** and connects at its other end by a pin and slot connection **219** to a hand lever **220**. The hand lever **220** is pivoted at **221** for swinging in a slot in the arm **206** and has an inwardly turned hooked end **222** which normally extends into an annular groove **223** formed concentrically in the gear **210**.

The hand lever **220** can be pushed inwardly, overcoming the force of the spring **215** to swing the hooked lever end **222** out of the groove **223** and the hooked lever end **213** out of the groove **214**. This will release that end of the transfer unit **34** and it can then be swung upwardly away from the cylinder **33** and about the supporting members **208** and **210** adjacent the cylinder **32**. The locking means at the other end can be released in a similar manner to permit upward swinging of that end of the transfer unit.

The conveyer of the transfer unit **34** is driven and is registered with the cylinders **32** and **33** by means of the gears **210** which mesh with the conveyer driving gears **224** and **225** (Figure 2) at opposite ends of the transfer unit. Each of these gears **224** and **225** is secured to an adjacent sprocket **226** and **227**, respectively. The combined gear and sprocket unit **224—226** is keyed on the adjacent end of a sleeve **228** and the combined gear and sprocket unit **225—227** is keyed on the corresponding end of a sleeve **229**. These sleeves are similarly mounted on the transfer frame tie rods **202** and **203** and in Figure 4 we have shown how the sleeve **229** is mounted on the rod **203**. The sleeve **229** is carried on the rod **203** by means of the bushings **230** at its opposite ends. The other ends of the sleeves **228** and **229** respectively carry the sprockets **231** and **232** (Figure 2) which are keyed thereon. Thus, there is provided a pair of sprockets **226** and **227** at one side for supporting the endless conveyer belt **233** and a pair of sprockets **231** and **232** at the opposite side for supporting an endless conveyer belt **234**.

The structure of the conveyer belts **233** and **234** is an important feature of this invention. The belts are illustrated in detail in Figures 7 and 8. Each belt is made of a continuous web or body **240** which has the transverse teeth or cleats **241** that cooperate with the sprockets as they pass therearound.

The web or body is made of rubber or similar material which is compressible and will be substantially free of noise in passing around the sprockets. This material will not be worn readily by the sprockets. To ensure extreme accuracy in the registering of the gripper bar, which is carried by the belts as will later appear, with the cylinders, there is embedded in the web longitudinally extending tensile members **242**, shown as being in the form of metal cables. These cables will not stretch under operating conditions of the press and, therefore, the belts can be made of accurate lengths and such accuracy will be maintained and accurate registry will be ensured.

The two belts are disposed within the side frame members **200** and **201**, as shown in Figure 4. The sprocket **227** has the inner end of its hub bearing against an inner guard plate **243** which is bolted to the frame member **201**. The sprocket **226** is similarly disposed relative to the guard plate. This plate **243** is provided with an endless guide slot **244** through which the carriage rollers of the transfer gripper bar will travel as will later appear. The frame member **200** is provided with a similar inner guard plate **245** which has the endless slot **246** in alignment with the slot **244**. The ends of the slots **244** and **246** are concentric with the adjacent tubes **228** and **229** and their upper and lower branches are parallel with each other. The sprockets **226** and **227** are identical with the sprockets **231** and **232** except that the driving gears **224** and **225** are associated with the sprockets **226** and **227**. The belts are kept in position laterally on each sprocket (Figure 4) by upstanding flanges **247** and **248**, the inner flange being removably mounted by bolts, as shown, to permit removal of the belts.

The tubular units including the rod **202** and the tube **228** at one end of the transfer unit and the rod **203** and tube **229** at the other end are connected together to prevent outward displacement or flexing, during operation of the transfer unit, by a reinforcing bar **250** (Figure 2) which extends longitudinally of the transfer unit and is disposed midway between the frame members **200** and **201**. This rod **250** is provided with an integral collar **251**

at one end through which the sleeve **228** passes and a collar **252** at its other end through which the tube **229** passes. The collar **251** has a cam **253** formed integrally therewith and the collar **252** has a cam **254** formed integrally therewith.

The manner in which the collar **252** is mounted on the sleeve **229** is shown in Figures 12 and 13 and the collar **251** is similarly mounted on the sleeve **228**. The collar **252** is disposed on a bushing **252***a* which is keyed to the sleeve **229** by a set-screw **255** and rotates therewith and within the collar. The collar **252** is prevented from moving axially by means of a lip **256** on one end of the bushing and a retaining ring **257** mounted on the other end of the bushing by a screw **255**. It will be apparent that the side frame members, the tube units and the reinforcing rod provide a rigid transfer unit free of deflection.

To ensure accuracy in registering the sheets we use only a single transfer gripper bar **260** (Figure 2) on our transfer unit **34**. Thus, the successive printed sheets are removed from one cylinder and delivered to the next by the same gripper bar which ensures registry with the next cylinder to which each sheet is transferred. This gripper bar extends transversely of the transfer unit **34** between the belts **233** and **234** and has its ends secured to such belts. The ends of the gripper bar are fastened to the belts **233** and **234** in the manner illustrated in Figure 4 and in Figures 7 and 8 where the belt **233** is shown. As shown in Figure 4, each end of the gripper bar **260** is provided with an attaching bracket **261** which is rigidly bolted thereto. The bracket **261**, as shown in Figures 7 and 8, is provided with a flat outward extension **262** which engages the outer surface of the web **240** of the belt in flat contact therewith. This extension is riveted to the web of the belt by a row of rivets **263** disposed between adjacent cleats or teeth **241**, the rivets passing between the cables **242**. Thus, the ends of the gripper bar will be securely fastened to the belts **233** and **234**.

The transfer gripper bar **260** includes the transversely extending gripper pad shaft **270** (Figures 6, and 9 to 11) and the transversely extending gripper shaft **271** which is disposed directly ahead of the shaft **270**. As shown in Figure 3, the shaft **270** is non-rotatably fitted on an inwardly projecting sleeve **272** which extends inwardly from a carriage roller bracket **273** provided at each end of the gripper bar **260**. The gripper shaft **271** is similarly fitted on an inwardly projecting sleeve **274** which is integral with an outwardly extending stub-shaft **275** that rotatably fits in the bracket **273**. Mounted on the bracket **273** concentrically with the shaft **275** is a leading roller **276** and mounted on the bracket behind the shaft **270** is a trailing roller **277**. Each set of rollers operates in one of the endless slots **244** and **246** formed in the respective side frame members **200** and **201**. To ensure registry of the sheet, handled by the gripper bar, laterally, each of the brackets **273** is provided with a vertical spindle **278** (Figure 2) on which a roller **279** is mounted. As shown in Figure 2, these rollers engage the inner faces of the plates **243** and **245** to keep the transfer gripper bar **260** in an exact position laterally of the transfer unit **34** during its travel longitudinally of such unit. The ends of the gripper bar **260**, as previously indicated, are attached by the brackets **261** to the belts **233** and **234**. The attaching brackets **261** are bolted to the carriage brackets **273** just ahead of the rollers **279** as shown in Figure 2.

Carried in alignment with the attaching bracket **261** at each end of the gripper shaft **271** is a shaft oscillating roller **280** which is mounted on a horizontal spindle rigidly carried by a collar **281** which is keyed to the end of the shaft **271**. If the collar **281** is oscillated, the shaft **271** is oscillated and, therefore, the grippers carried thereby are oscillated. The collar is oscillated by the roller **280** engaging cams at the ends of the transfer unit as the gripper bar **260** travels therearound. These gripper shaft oscillating cams are provided on each end of each of the side plates **200** and **201** which support them at the inner edges of the respective roller guide slots **243** and **245** where they curve around the lower sides of the tubes **228** and **229**, adjacent the sprockets **226**, **227**, **231** and **232**, as shown in Figures 2, 5 and 6, and are designated respectively by the numerals **281**, **282**, **283** and **284** in Figure 2. Figure 5 shows the cam **284**, adjacent the sprocket **227**, in detail. To aid in obtaining exact registry of the gripper bar **260** axially of the cylinder shells **154** during the transfer periods, cam bosses **285**, **286**, **287** and **288** are formed on the inner surfaces of plates **200** and **201** adjacent the cams **281**, **282**, **283**, and **284** so that the gripper bar rollers **279** will cooperate therewith and the gripper bar will be accurately located axially of the cylinder shells during the transfer periods.

To prevent deflection of the transfer gripper bar **260** during its travel around the transfer unit, it is trussed for reinforcement by truss members in the form of the wires **290** which extend from one end of the rod to the other at the leading and trailing sides of the rod. These members have their ends anchored in the carriage brackets **273** and pass through notches in the outer ends of the oppositely extending diametrically opposed radial arms **291** which are carried by a bracket **292** midway between the ends of the gripper bar. The gripper pad shaft **270** is keyed in this bracket **292** while the gripper shaft **271** is oscillatable therein. This bracket **292** also carries a pair of rollers **293** which are mounted on horizontal spindles and which are adapted to cooperate with the anti-deflection cams **253** and **254** provided on the collars **251** and **252** at each end of the transfer unit. These cams **253** and **254** as indicated in Figure 12 are engaged by the rollers **293** as the gripper bar passes around the end of the transfer unit in order to prevent centrifugal force from causing the gripper bar **260** to bow outwardly at its midpoint during the high speed travel of the transfer unit. This will also help in obtaining exact registry at the critical transfer point. To further aid in obtaining exact registry, the gripper bar **260** (Figures 4 and 16) is provided at each end with register racks for cooperating with similar racks on the impression shells of cylinders **32** and **33**. As shown in Figure 16, each rack **300** is provided at the inner side of the carriage bracket **273** being suitably bolted thereto. The register racks **300** on opposite ends of the gripper bar **260** will cooperate with register racks **301** carried on each end of each cylinder shell **154**, being bolted thereto as shown in Figures 4 and 16. The racks **301** on the cylinder shells are so located that they cooperate at the proper times with the racks **300** during the sheet transfer periods.

It will be understood that the cylinders **32** and **33** are provided with the usual grippers and gripper pads and with the usual means for operating them. In Figures 9 to 11, we have illustrated the cylinder **33** provided with the pads **294** and with the cooperating grippers **295**. The operating mechanism for the grippers **295** will serve to swing the grippers relative to the pads to open and close the grippers at the proper times. The gripper shaft **271** carries the transfer grippers **296** which cooperate with the gripper pads **297** carried on the shaft **270** in alignment therewith. The grippers **296** oscillate with the shaft **271** relative to the pads **297**. It will be understood that the transfer grippers **296** are in alignment with the pads **297** but are staggered relative to the cylinder grippers **295** and the pad **294**.

The function of the tranfer unit **34** in transferring the sheet S from the cylinder **33** is illustrated in Figures 9 to 11. As the cylinder **33** rotates in the direction indicated, the transfer gripper bar **260** will be moved in the direction indicated and will be approaching the cylinder. The sheet S (Figure 9) will at this time be gripped between the cylinder grippers **295** and the pads **294**. The transfer grippers **296** will be spaced from the transfer gripper pads **297**. As the bar **260** continues to move, the grippers **296** will be rocked into engagement with the

pads 297 as shown in Figure 10. As the gripper bar 260 continues to move and the cylinder 33 continues to rotate, the cylinder grippers 295 are rocked away from the cylinder gripper pads 294 to free the sheet and complete its transfer to the bar 260 as shown in Figure 11 where it is gripped by grippers 276 and pads 277. Exact registry of the transfer gripper bar 260 laterally relative to the cylinder 33 during the transfer period results from the rollers 273 cooperating with the cam surfaces 285 and 286 on the side plates 243 and 245. Circumferential registry is accomplished by the register racks 300 at each end of the bar 260 gradually entering into registry with the register racks 301 on the cylinder shell 154 as the gripper bar 260 moves around the end of the transfer unit. Deflection of the bar 260 as it approaches transfer position is prevented by the rollers 293 engaging the cam 253 or the cam 254. The belts 233 and 234, due to their nature, can be formed accurately of exact dimensions, with the bar 260 located accurately longitudinally thereof and the belts will not stretch due to the cables therein, the gears 10 performing a registering function as well as a driving function. Thus, exact registry longitudinally of the transfer unit, axially of the cylinders and circumferentially of the cylinders, will be obtained even at very high speeds. The sheet will now be carried by the transfer gripper bar 260 over a plate or web 298 (Figures 2 and 5) which is provided between the side frame members 200 and 201 at the lower edges thereof and which extends between the two cylinders 32 and 33. As the gripper bar 260 approaches the cylinder 32, the various registering and anti-deflection devices will function in the manner previously indicated and the gripping means on the bar and the cylinder will function in the same manner as illustrated in Figures 9 to 11 but in a reverse order so as to transfer the sheet from the bar 260 to the cylinder 32. Due to the nature of the belts 233 and 234, wear will be at a minimum. Also, noise of the operation of the transfer unit will be kept at a minimum.

The belts 233 and 234 will be driven at all times from the cylinder driving means and in time relationship thereto. Both gears 210, driven with the cylinders 32 and 33, will engage the belt driving gears 224 and 225 to drive the belts in timed relationship to the cylinders. This drive will be maintained during lifting of one or both of the cylinders by means of the eccentric cylinder lifting means which includes the crank and rod arrangement 162 of Figure 1. Lateral displacement of the transfer unit 34 is precluded by the arms 205 engaging the outer sides of the frame portions 159 (Figure 4) and the arms 206 engaging the outer surfaces of the gears 210. Either end of the transfer unit may be swung up out of the way, to facilitate make-ready as previously indicated.

With reference to Figure 1, a suitable feedboard arrangement, illustrated diagrammatically at 310, will be provided for feeding the sheets S to cylinder 33 and a suitable delivery mechanism, illustrated diagrammatically at 311, will be provided for taking the sheets from the cylinder 32. The delivery mechanism is driven by cylinder gear 143 as shown. The feed from feedboard 310 to the cylinder 33 will occur just as the cylinder 33 comes to a stop. Similarly, the delivery of the sheet from the cylinder 32 to the delivery mechanism 311 will occur just as the cylinder 32 comes to a stop.

Having thus described our invention, what we claim is:

1. A flat bed and cylinder printing press comprising a bed and a plurality of rotatable cylinders disposed transversely of the bed and spaced longitudinally thereof, said bed supporting a plurality of type forms extending transversely thereof and spaced longitudinally thereof for cooperating respectively with the spaced cylinders, means for rotating the cylinders, transfer mechanism between the cylinders for transferring a sheet from one cylinder to the next, said transfer mechanism comprising an endless conveyer extending from one cylinder to the next, said conveyer comprising endless belts made of non-metallic material having endless longitudinally extending tensile members embedded therein, and means carried by the belts for gripping the sheet, comprising a pair of parallel longitudinally extending belts, said transfer mechanism including a transversely extending gripper rod unit having its ends fastened to said belts, and means for ensuring that the rod unit will register transversely with the cylinders, said means comprising guide members carried by the gripper rod unit and relatively fixed longitudinal guide plates extending between said cylinders.

2. A flat bed and cylinder printing press comprising a single reciprocable bed and a plurality of rotatable cylinders and consisting of at least one pair of first and second cylinders disposed transversely of the bed and spaced longitudinally thereof, said bed supporting longitudinally spaced transversely extending type forms for cooperating with said first and second cylinders respectively, means for rotating all the cylinders at the same speed in one direction only and all in the same direction at all times, means for supporting the cylinders for movement towards and from the bed in synchronism with the movement of the bed so that they contact therewith during the printing stroke and are spaced therefrom during the return stroke, transfer mechanism extending between the first and second cylinders for transferring a sheet from the first cylinder to the second cylinder, means for supporting said transfer mechanism for movement with the cylinders towards and from the bed, said transfer mechanism comprising an endless conveyor in the form of endless belts extending from the first cylinder to the second cylinder only, a single sheet gripper rod unit carried by the conveyer so that each successive sheet will be gripped by the same gripper rod unit to insure registry with the next cylinder and means for operating said gripper rod unit in timed relationship to the rotation of the cylinders to grip a sheet and remove it from one cylinder and release it to the next cylinder, said means comprising an actuating member mounted on the gripper rod unit and means adjacent said cylinder for engaging said actuating member, said transfer unit being supported by a pair of side frame members extending the length of the unit and disposed at right angles to the gripper rod unit, endless roller guides carried by said side members and extending the length thereof, said gripper rod unit having guide rollers mounted on its ends which operate in said guides to guide the gripper rod unit during its complete cycle of travel with said belts.

3. A printing press according to claim 2 wherein the means for ensuring registry of the gripper rod unit transversely comprises rollers carried by the ends of the rod unit on axes at right angles to the axes of said guide rollers and which engage said side frame members.

4. A printing press according to claim 3 in which the side frame members are connected together at their ends by transverse connecting rods, cams carried by said rods intermediate their ends, and rollers carried by said gripper rod unit for engaging said cams as the rod unit travels around the ends of said conveyer to prevent flexing of the rod unit by centrifugal force.

5. A printing press according to claim 4 in which a reinforcing rod extends longitudinally between said side frame members and is connected at its opposite ends to said transverse connecting rods.

6. A printing press according to claim 5 in which the gripper rod unit is provided with reinforcing trussing extending longitudinally thereof, said trussing being in the form of wires extending from one end to the other of said rod unit, and radially extending arms intermediate the ends of said rod unit which engage said wires and bow them outwardly.

7. A printing press according to claim 5 in which sprocket shafts extend through said connecting rods which are hollow, sprockets on the opposite ends of said shaft and upon which said endless members in the form of chains are mounted, and means for driving said sprockets.

8. A printing press according to claim 7 in which said gripper rod unit includes movable grippers, means for operating said grippers as the rod unit is carried around the ends of the conveyer, said operating means comprising cams supported at the ends of said frame members and rollers carried at the ends of said rod unit for engaging said cams as the rod unit is carried around the ends of the conveyer.

9. A printing press according to claim 8 in which the supporting means for the transfer unit comprises rotatable eccentric members associated with the cylinders, and supporting arms secured to said frame members and carried by said eccentrics.

10. A printing press according to claim 9 in which said arms have yokes which straddle the eccentrics, and means for locking the arms in association with the eccentrics.

11. A printing press according to claim 10 in which

an independent locking means is provided at each end of the transfer unit.

12. A printing press according to claim 9 including means associated with the eccentrics for driving the sprockets continuously, said means comprising gears carried by and concentric with said sprockets which mesh with gears carried by and concentric with said cylinders.

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